



Yield Hall Place 1 & 2, The Oracle

Air Quality Assessment

For The Oracle Limited Partnership

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1. Introduction

Hydrock have been commissioned by The Oracle Limited Partnership to prepare an Air Quality Assessment (AQA) to support the planning application for the mixed-use development (the 'Proposed Development') at the former Debenhams and Vue within The Oracle, Reading (The 'Site'). The Site is located in within the shopping district of Reading town centre within the administrative boundary of Reading Borough Council (RBC).

The Site is centred on the National Grid Reference (NGR); x471720, y173210 and shown below in Figure 1. The Site is split by the River Kennet which runs from west to east. The southern Site (existing Vue building) is bound by the A329 and London Street to the south and east respectively. The Oracle multistorey car park (MSCP) lies immediately to the west. The northern Site (Debenhams building) is bound by the Oracle shopping mall to the west. Yield Hall Place borders the Site to the east, beyond which lie further retail and commercial properties. The closest residential properties are situated on London Street to the north east and south east of the Site.

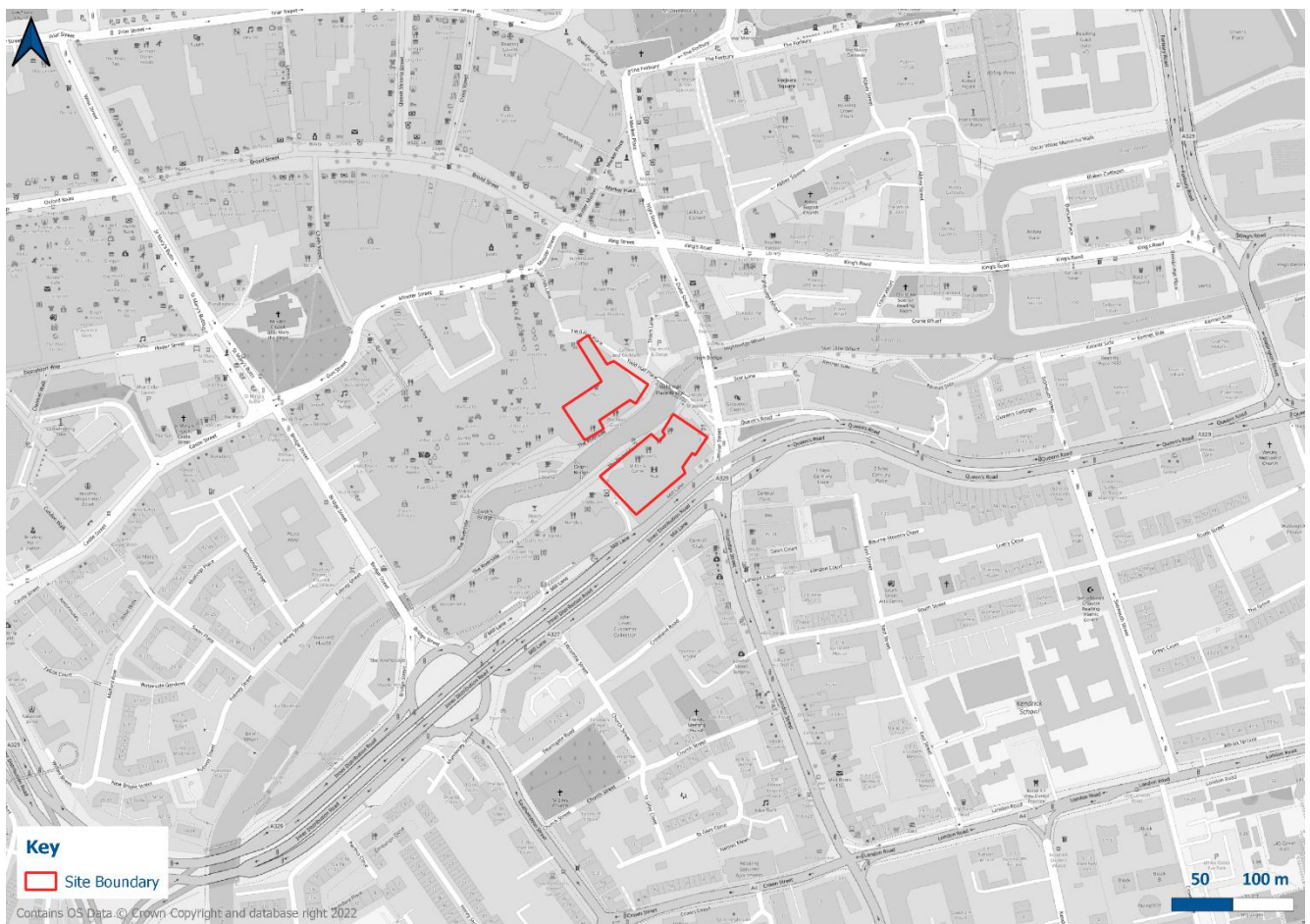


Figure 1: Site Location

1.1 Proposed Development

Planning permission is sought for the repurposing and redevelopment of sites at the eastern end of the Oracle to provide a mixed use development comprising residential and town centres uses. The proposals focus around two main sites:

- » Former Debenhams department store at the eastern end of the Oracle shopping centre building and northern side of the River Kennet, to be known as Yield Hall Place 1; and

- » Vue cinema building on the southern side of the River Kennet and to the east of the Oracle Riverside multi storey car park, to be known as Yield Hall Place 2.

Two detailed planning applications are submitted; one application for Yield Hall Place 1 and one application for Yield Hall Place 2. These applications will be submitted concurrently to RBC and expected to be considered and determined in this way by the local planning authority. This report is submitted in respect of both applications and assesses the proposals as a single scheme for the purpose of the technical assessment undertaken. An illustrative plan is submitted with both planning application which identifies the full extent of the proposed developments, and the schemes assessed for the purposes of this report.

Where matters only pertain to one of the planning application sites, these are specifically identified within the report.

A description of each development is provided below:

Yield Hall Place 1 (Former Debenhams)

Mixed use development comprising part demolition of former department store and erection of new building comprising build to rent residential use (Class C3) and commercial uses within Uses Class E. Reconfiguration and change of use of remaining department store floorspace (Class E) to uses with within Use Class E and / or bar (Sui Generis Use) and / or experiential leisure use (Sui Generis Use). Associated public realm, infrastructure works and external alterations to shopping centre, including creation of new shopping centre entrance.

Scheme details include:

- » No of Residential units: 202;
- » Proposed leisure unit: 935 sqm (GIA/Gross Lettable Area);
- » Retained retail floorspace: 3,541 sqm (including riverside floor back of house);
- » Ground floor co-working space and maker units: 728 sqm; and
- » Maximum building height: 106,000 AOD

Yield Hall Place 2 (Vue Cinema)

Mixed use development comprising demolition of existing buildings and erection of new building comprising build-to-rent residential use (Class C3), cinema (Sui Generis) and ground floor commercial uses within Use Class E. Associated public realm and infrastructure works

Scheme details include:

- » No of Residential units: 247;
- » Replacement cinema 2,653 sqm / 6 screens;
- » Ground floor commercial space (excluding cinema) 464 sqm; and
- » Maximum building height 98,000 AOD.

1.2 Purpose of Air Quality Assessment

The assessment describes the scope, relevant legislation, assessment methodology and the baseline conditions currently existing in the area. It then presents an assessment of potential impacts during the construction and operational phases of the Proposed Development, and an evaluation of the significance of these effects with respect to air quality.

2. Relevant Legislation

2.1 Air Quality Regulations and Objectives

There are two sets of air quality legislation which include ambient air quality thresholds for the protection of public health that apply in England, these include legally binding limit values originally set by the European Union (EU) Directive 2008/50/EC¹ on ambient air quality and cleaner air for Europe; and regulations implementing national air quality objectives as set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)² which local authorities are required to work towards achieving.

The EU (Withdrawal Agreement) Act 2020 sets out arrangement for implementing air quality limit values that are included in the EU Directive on ambient air quality and cleaner air for Europe (2008/50/EC) included in the following:

- » Air Quality Regulations (SI 2010 No.1001)³ and amended (SI 2016 No.1184)⁴ ;
- » The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (SI 2019 74)⁵ ;
- » The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (SI 2020 1313)⁶ amend the Air Quality Regulations (SI 2010 No.1001) to account for EU withdrawal; and
- » The AQS objectives are implemented in the Air Quality (England) Regulations 2000 (SI 2000/928)⁷ and Air Quality (England) (Amendment) Regulations 2002 (SI 2002/3043)⁸.

The Air Quality Strategy 2007 Volume 12 sets out the government's policies and framework for improving air quality in the UK with the aim of meeting the requirements of above legislation. The Air Quality Strategy also outlines the Limit Values, Target Values, Standards, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment (collectively termed Air Quality Assessment Levels (AQALs) throughout this report). Those relevant to this assessment is provided below, in Table 1:

Table 1: National Air Quality Objectives

Pollutant	Averaging Period	AQALs	
NO ₂	1 Hour Mean	200 µg/m ³	Not to be exceeded more than 18 times in a year.
	Annual Mean	40 µg/m ³	

¹ Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe Available at: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32008L0050>

² Defra. "The Air Quality Strategy for England, Scotland, Wales and Northern Ireland". Available at: <https://www.gov.uk/government/publications/2010-to-2015-government-policy-environmental-quality/2010-to-2015-government-policy-environmental-quality#appendix-5-international-european-and-national-standards-for-air-quality>

³ The National Archives. "The Air Quality Standards Regulations 2010". Available at: <http://www.legislation.gov.uk/uksi/2010/1001/contents/made>

⁴ The National Archives (2016). "The Air Quality Standards (Amendment) Regulations 2016". Available at: <https://www.legislation.gov.uk/uksi/2016/1184/contents/made>

⁵ The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2019/74/contents/made>

⁶ The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2020/1313/contents/made>

⁷ The National Archives. "The Air Quality (England) Regulations 2000". Available at: <http://www.legislation.gov.uk/uksi/2000/928/contents/made>

⁸ The National Archives. "The Air Quality (England) (Amended) Regulations 2002". Available at: <http://www.legislation.gov.uk/uksi/2002/3043/contents>

Pollutant	Averaging Period	AQALs	
PM ₁₀	24 Hour Mean	50 µg/m ³	
	Annual Mean	40 µg/m ³	
PM _{2.5}	Annual Mean	20 µg/m ³	

Defra's Local Air Quality Management Technical Guidance 2022 (LAQM.TG(22))⁹ provides guidance on where the above AQAL's should apply. This is summarised below, in Table 2.

Table 2: Summary of where AQALs should apply

Averaging Period	Objectives should apply at:	Objectives should generally NOT apply at:
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to other locations at the building façade) or any other location where public exposure is expected to be short term.
24 Hour Mean and 8 Hour Mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties	Kerbside sites (as opposed to other locations at the building façade) or any other location where public exposure is expected to be short term.
1 Hour Mean	All locations where the annual Mean and: 24 and 8-hour mean objectives apply. Kerbside site (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railways stations etc. which are not fully enclosed, where members of the public might be expected to spend one hour or more. Any outdoor locations where members of the public might	Kerbside sites where the public would not be expected to have regular access.

⁹ Defra, "LAQM Technical Guidance (TG22)" (Department for Food, Environment and Rural Affairs (Defra), August 2022), <https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf>

Averaging Period	Objectives should apply at:	Objectives should generally NOT apply at:
	reasonably expect to spend one hour or longer.	
15 Minute Mean	All locations where member of the public might reasonably be exposed for a period of 15 minutes	

2.2 Local Air Quality Management

Obligations under the Environment Act 2021¹⁰ (which provides an amendment to the Environment Act 1995¹¹) requires local authorities to review and assess air quality in their administrative boundaries. Where AQALs are predicted to be exceeded, the local authority must declare an Air Quality Management Area (AQMA) at sensitive receptor locations and formulate an Air Quality Action Plan (AQAP) to reduce pollution concentrations to values below AQALs.

RBC's declared AQMA and subsequent AQAP are discussed in Section 4.1.

2.3 National Planning Policy Framework

The National Planning Policy Framework (NPPF)¹² sets out the Government's planning policy for England. It requires planning decisions for any new development to prevent new and existing development from contributing to, or being put at risk from, unacceptable levels of air pollution (paragraph 174). It also states that planning decisions should sustain and contribute towards compliance with relevant limit values or national objectives for air pollutants, taking into account the presence of AQMAs and Clean Air Zones (CAZ)s (paragraph 186), and the cumulative impacts from other sites (paragraph 185).

Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. Furthermore, planning decisions should ensure that any new development in AQMAs and CAZs is consistent with the local air quality action plan.

Also, to help reduce congestion and emissions, to improve air quality and public health, significant development should be focused on locations which are / can be made sustainable through limiting the need to travel (paragraph 105).

2.4 Planning Practice Guidance

Reference ID 32 (Air Quality) of the National Planning Practice Guidance (NPPG)¹³, which was updated in November 2019, provides guiding principles on how planning can take account of the impact of new development on air quality. The NPPG summarises the importance of air quality in planning and the key legislation relating to it.

¹⁰ <https://bills.parliament.uk/bills/2593/publications>

¹¹ Environment Agency, "Environment Act 1995" (The Environment Agency, 2002), <http://www.legislation.gov.uk/ukpga/1995/25/contents>.

¹² Ministry of Housing, Communities and Local Government, "National Planning Policy Framework," July 2021, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004408/NPPF_JULY_2021.pdf.

¹³ Ministry of Housing, Communities & Local Government, "Reference ID (32) Air Quality" (Ministry of Housing, Communities & Local Government, 2019), <https://www.gov.uk/guidance/air-quality--3>.

2.5 Local Planning Policy

The Reading Borough Local Plan (adopted November 2019)¹⁴ sets out the long-term vision, objectives and strategic planning policies for Reading up to 2036. The following policies relate to air quality and state:

"CC8: SAFEGARDING AMENITY"

Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:

[...]

- *Dust and fumes;*
- *Smell;*

[...]

Where the proposals involve new development of more than 8 storeys. The position of habitable rooms, windows and outdoor living spaces will be particularly important. A back-to-back distance of 20 metres between dwellings is usually appropriate, although the circumstances on individual Sites may enable dwellings to be closer without a detrimental effect on privacy.

As well as immediate impacts, other aspects to which this policy applies will include matters such as hours of operation of businesses, and effects of traffic movements, particularly of heavy goods vehicles (HGVs).

Proposals which would generate regular movements of HGVs on residential roads will not be acceptable. Where an otherwise acceptable development could change its character to a use that would have a greater impact on amenity without needing planning permission, conditions will be applied to restrict such changes.

ENV15: AIR QUALITY

Development should have regard to the need to improve air quality and reduce the effects of poor air quality.

i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:

- * Whether the proposal, including when combined with the cumulative effect of other developments already permitted, would worsen air quality;*
- * Whether the development is within, or accessed via, an Air Quality Management Area; and*
- * Whether it can be demonstrated that a local worsening in air quality that would not detrimentally affect human health or the environment would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.*

ii. Where a development would introduce sensitive uses (such as residential, schools and nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application. If there are significant detrimental effects that cannot be mitigated, the application should be refused.

¹⁴ Reading Borough Council, "Reading Borough Local Plan," November 2019, https://images.reading.gov.uk/2019/12/Local_Plan_Adopted_November_2019.pdf.

iii. Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring.

CR6: LIVING IN CENTRAL READING

Proposals for residential development within the central area will be assessed against the following criteria:

[...]

ii) Proposals for new residential development within the central area will be required to demonstrate how the issue of potential noise disturbance from neighbouring land uses and other sources, and air quality implications of residential development, have been considered and if necessary, mitigated. New residential development should not be located next to existing town centre uses where those uses would give rise to unacceptable levels of noise and disturbance to the occupiers of the new scheme, unless this can be mitigated.

CS34: POLLUTION AND WATER RESOURCES

Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; where it would preserve or ideally enhance ground and surface water quality; and where existing water resources, sewerage and wastewater treatment infrastructure are adequate to support the proposed development.

Proposals for development that are sensitive to the effects of air, noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution."

3. Methodology

3.1 Consultation

Full details of the AQA approach were sent via email to RBC in October 2022 with a request for further comment / guidance. The following response was received on 12 October 2022:

"That sounds reasonable to me, it is also worth noting that where there is a predicted worsening of air quality, even if it is not deemed 'significant', we would be looking for mitigation measures to offset the worsening"

The above comments have been taken into consideration and the approved methodology is outlined below.

3.2 Guidance

The following guidance has been used to undertake this Air Quality Assessment:

- » Defra's LAQM.TG(22)⁹;
- » EPUK & IAQM Land-use Planning & Development Control: Planning for Air Quality¹⁵;
- » The IAQM's guidance on assessing impacts from construction¹⁶; and
- » Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites¹⁷.

3.3 Baseline Air Quality

The baseline air quality conditions in the vicinity of the Site have been established through the compilation and review of the following sources. The Baseline Assessment can be found in Section 4.

- » Data from the National Atmospheric Emissions Inventory (NAEI)¹⁸, Environment Agency (EA)¹⁹ and Defra's Pollutant Release and Transfer Register (PRTR) data²⁰;
- » Defra's modelled background concentrations of AQS pollutants (UK-AIR)²¹. These estimates are produced using detailed modelling tools and are available as concentrations at central 1km² National Grid square locations across the UK. Mapped background concentrations have been obtained based upon the 2018 base year Defra update (August 2020 publication);
- » Defra's predicted roadside concentrations of NO₂ produced from their pollution climate model (PCM)²²;
- » Multi Agency Geographic Information for the Countryside (MAGIC)²³ and;

¹⁵ EPUK & IAQM, "Land-Use Planning & Development Control: Planning for Air Quality" (Institute for Air Quality Management (IAQM), January 2017), <http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf>.

¹⁶ IAQM, "Guidance on the Assessment of Dust from Demolition and Construction" (Institute of Air Quality Management (IAQM), February 2014), <http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf>.

¹⁷ IAQM, "A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites" (Institute for Air Quality Management (IAQM), June 2019), <https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2019.pdf>.

¹⁸ National Atmospheric Emissions Inventory, UK Emissions Interactive Map (beis.gov.uk).

¹⁹ <https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory>

²⁰ UK Pollutant Release and Transfer Register (PRTR) <https://prtr.defra.gov.uk/map-search>

²¹ UK-AIR, "Background Mapping Data for Local Authorities - 2018," n.d., <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018>.

²² <https://uk-air.defra.gov.uk/data/gis-mapping/>

²³ <https://magic.defra.gov.uk/MagicMap.aspx>

- » RBC's latest available air quality monitoring data, derived from the latest available air quality annual status report published in 2020²⁴.

3.4 Construction Phase Assessment

3.4.1 Dust Risk Assessment

The construction dust risk assessment is provided in Section 5 and has been undertaken in line with IAQM guidance. This considers the risk of impacts during the construction phase in terms of nuisance dust, human health (PM₁₀ exposure) and ecological impacts.

With regard to ecological receptors, risk assessment should be taken where high-sensitivity receptors are located within 50m of a Site boundary. The Multi Agency Geographic Information for the Countryside (MAGiC) website, which incorporates Natural England's interactive maps²⁵, has been reviewed to identify whether any statutory ecological sensitive receptors are situated within 50m of the Site boundary or within 50m of any routes used by construction vehicles on the public highway, up to 500m from the Site entrance. *No receptors were identified within 50m of the Site boundary or Trackout route and therefore no further consideration of ecological receptors is required.*

Sensitive receptors were identified within 350m of the site boundary. Based on the IAQM guidance residential dwellings, museums, car parks and car show room are indicative examples of high sensitivity receptors in relation to both dust soiling and health effects of PM₁₀. Indicative examples of medium sensitivity receptors include places of work, such as offices.

The IAQM guidance states that the potential dust emission magnitude from Demolition, Earthworks, Construction and Trackout should all be assessed individually. In addition, the sensitivity of the area to adverse dust impacts should also be defined.

The overall significance of the risk of adverse impacts during the construction phase can then be defined using the 'risk of impacts matrix' for each stage of the construction phase described above.

3.4.2 Construction Traffic Emissions

The potential impact of construction vehicle emissions on local air quality has been evaluated using criteria given in guidance published by EPUK/IAQM guidance²⁵.

3.5 Operational Phase Assessment

3.5.1 Scope of Impact Assessment

The scope of assessment has been determined against the EPUK and IAQM's two stage checklist criteria²⁵. The Stage 1 criteria identifies whether a development requires an air quality assessment. As the proposals include more than 10 residential dwellings, consideration of Stage 2 is required.

Stage 2 includes some criteria which are not directly relevant to the Proposed Development, such as those related to the realignment of roads within an AQMA, introduction of a new bus station, new road junctions and underground car parks. These have been excluded from this assessment and only relevant screening criteria have been included. The relevant checklist criteria shown in Table 3 identifies whether a detailed assessment of potential air quality impacts is required.

²⁴ Reading Borough Council, 2020 Air Quality Annual Status Report (ASR), In fulfilment of Part IV of the Environment Act 1995 Local Air Quality Management, June, 2020

²⁵ Natural England and MAGiC partnership organisations., "Multi Agency Geographic Information for the Countryside,," 2020, <https://magic.defra.gov.uk/MagicMap.aspx>.

Table 3: EPUK & IAQM Assessment Criteria

Criteria	The Development Will:	Indicative Criteria to Proceed to a Detailed AQA:
1	Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV - cars and small vans <3.5t gross vehicle weight)	A change of LDV flows of: » more than 100 AADT within or adjacent to an AQMA » more than 500 AADT elsewhere
2	Cause a significant change in Heavy Duty (HDV) flows on local roads with relevant receptors (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: » more than 25 AADT within or adjacent to an AQMA » more than 100 AADT elsewhere.
3	Have one of more substantial combustion processes, where there is a risk of impacts at relevant receptors. NB. This includes combustion plant associated with standby emergency generators (typically associated with centralised energy centres) and shipping.	Typically, any combustion plant where the single or combined NOx emission rate is less than 5mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent stack in a location and at a height that provides adequate dispersion. In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situation where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emissions rates. Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable.

As the Site is located within the Reading AQMA the more stringent criteria apply. As the Proposed Development is car free it is not anticipated to generate vehicle trips above 100 Annual Average Daily Traffic (AADT). However, based on local monitoring concentrations and the introduction of sensitive receptors close to an AQMA, a detailed AQA has been undertaken in accordance with EPUK & IAQM guidance to assess potential exposure to air pollutants from traffic on the local road network.

There are no substantial combustions sources associated with the Proposed Development or situated within the locale, as such impacts from these sources are not discussed further.

Based on the above, a detailed assessment of air quality impacts from scheme-generated traffic has been undertaken, in accordance with EPUK & IAQM guidance, according to the methodology outlined below.

3.5.2 ADMS-Urban Dispersion Model

A detailed AQA has been undertaken using the air dispersion model ADMS-Urban v5.1 to establish the current and future air quality conditions in the area. The software is commercially available, has been validated for this type of assessment by Defra and is used extensively for AQA's.

ADMS-Urban is able to provide an estimate of air quality both before and after development, considering important input data such as background pollutant concentrations, variable emissions, meteorological data, and traffic flows.

3.5.3 Assessment Scenarios

The following scenarios have been modelled:

- » Baseline/verification 2019; and
- » 2025 Opening Year (2025 OY) – Proposed development opening year traffic flows

3.5.4 Model Inputs

3.5.4.1 Traffic Data

Traffic data used in the model was obtained from Department for Transport (DfT) data. TEMPro factors were applied to the data to calculate opening year traffic flows, which also accounts for local growth. The modelled road links are shown in Figure 2 below, with full details provided in Appendix A.

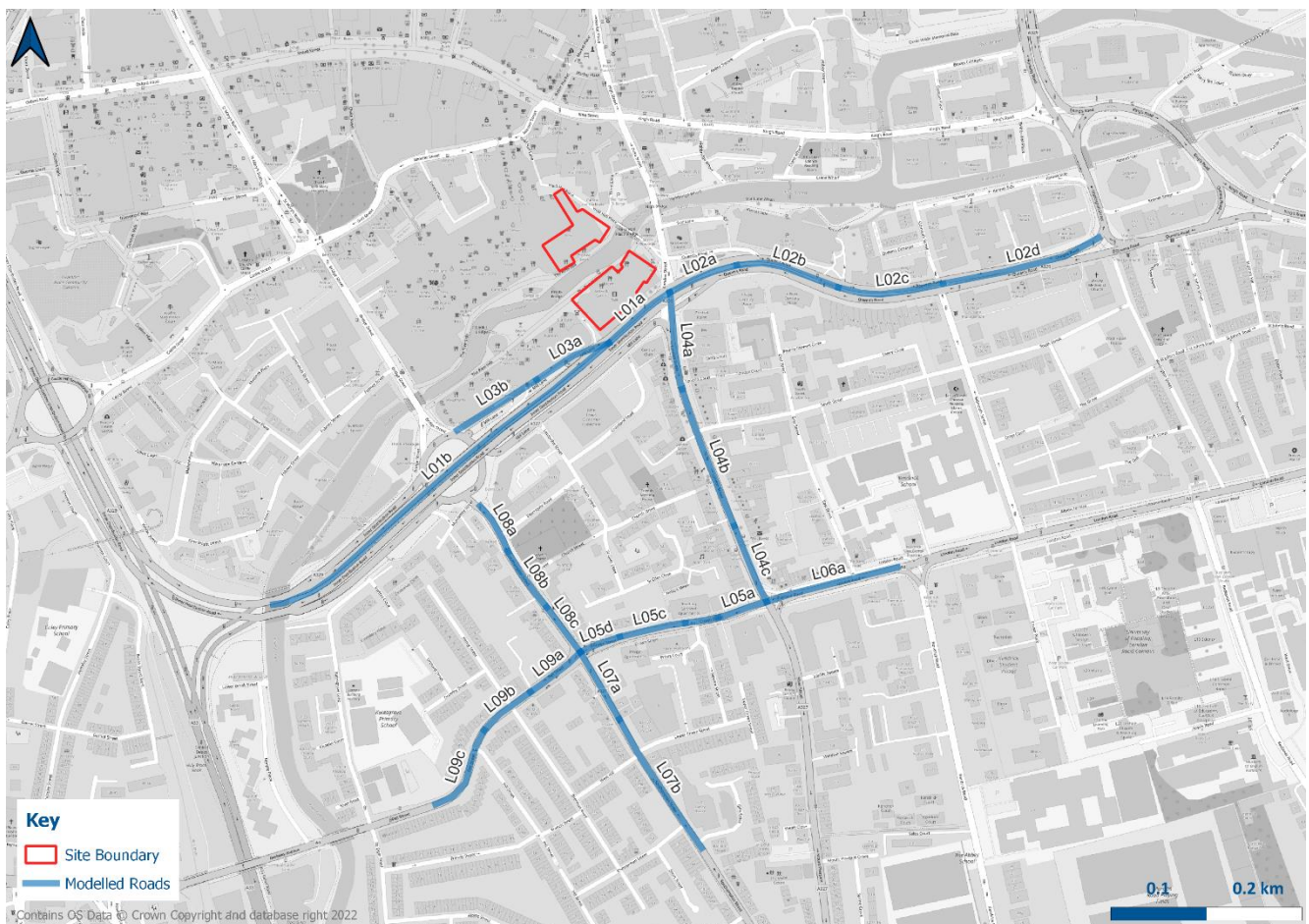


Figure 2: Links Modelled

Traffic data for the adjacent multistorey car park (MSCP) was provided by Stantec, the Transport Consultants for the scheme.

For each road link, vehicle speeds were obtained from the speed limit for each road derived from the OpenStreet Browser v4.10²⁶, which has been used as a proxy for average speeds on the network. Vehicle speeds were reduced within 50m of junctions relative to the speed limit to account for queuing and congestion in the average speed profile, in accordance with LAQM.TG (22). Google typical traffic was used to assist with determining appropriate slow down speeds across the study area.

3.5.4.2 Riverside MSCP

The Riverside MSCP adjacent to the Site was included in the model. In accordance with LAQM.TG(22) and CERC user note 54 (Modelling Car Parks), the existing car park was modelled as a volume source. Emissions were calculated using the latest Emissions Factor Toolkit (EFT)(v.11). and NAEI cold start emissions²⁷.

3.5.4.3 Emission Factors

Emission rates for NO_x, PM₁₀ and PM_{2.5} used for the dispersion modelling assessment were calculated from the latest EFT(v.11).

Most modern vehicles on the road in the UK meet a particular Euro emissions standard from 1 – 6, with 6 being the newest. Different parts of the country have newer or older vehicles than others. This is defined as the "fleet". The EFT estimates this primarily based on whether the location is within or outside London or in England, Wales or Scotland. In the case of this model the vehicle fleet used was "England (urban)".

When predicting future year emissions, the toolkit includes forecasts such as anticipated advances in vehicle technology and changes in vehicle fleet composition, which assumes that vehicle emissions will reduce over time. However, there is some uncertainty over the accuracy of the future predictions.

3.5.4.4 Temporal Variation (Diurnal Traffic Profile)

Temporal variation in traffic flows along roads have been included in the dispersion model to account for the realistic differences that would occur between weekdays and weekends. Accordingly, a time varying profile was included in the model.

The diurnal profile used in the model for the modelled road links has been calculated based on DfT Road traffic statistics (TRA) dataset. TRA0307 provides 'Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2019'²⁸, which shows the average hourly traffic flow in each combination of weekday and hour, relative to the average hour across the whole year for main roads in England. Figure 3 shows the diurnal traffic profile included in the model for the road sources.

A separate diurnal profile was applied to the MSCP, which was provided by Stantec and based on car barrier data and extrapolated hourly footfall data.

²⁶ https://www.openstreetbrowser.org/#map=15/53.7033/-1.2698&categories=car_maxspeed

²⁷ <https://naei.beis.gov.uk/data/ef-transport>

²⁸ DfT, "Average Annual Daily Flow and Temporal Traffic Distributions (TRA03) - Statistical Data Sets - GOV.UK," 2015, <https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow>.

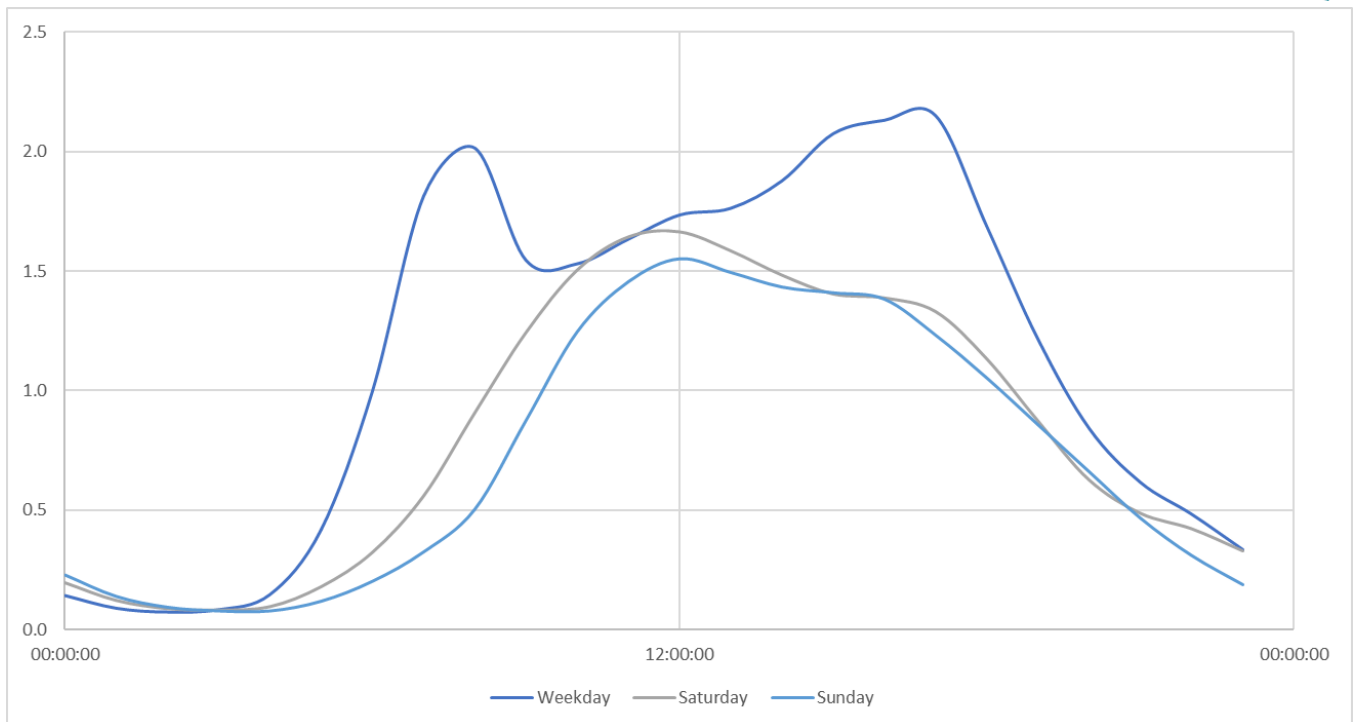


Figure 3: Diurnal traffic profile included in the dispersion model

3.5.4.5 Meteorological Parameters

To calculate pollutant concentrations at identified sensitive receptor locations the dispersion model uses hourly sequential meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion.

The dispersion modelling has been undertaken using 2019 data from Farnborough. This site is located approximately 24km south east of the Site. It is also the closest and most relevant meteorological station that records all of the parameters necessary for dispersion modelling. The dataset has been supplemented with meteorological data from Odiham station due to low data capture. A wind rose is presented in Appendix C.

3.5.4.6 Surface Characteristics

The following surface roughness parameters have been applied in the model:

- » Dispersion site surface roughness = 1m (ADMS pre-set 'cities and woodland');
- » Met site surface roughness = 0.02m (ADMS pre-set 'open grassland');

The following Minimum Monin-Obukhov (MO) lengths were applied:

- » Dispersion site = 30m (Cities and Large Towns);
- » Met site = 10m (Small Towns <50,000).

3.5.5 Receptors Included in the Dispersion Model

3.5.5.1 Human Receptors

Sensitive receptor locations included in the dispersion model are shown below in Figure 4 and Table 4. These are worst-case locations within the Site boundary at locations of relevant exposure. It is worth noting that no residential units are proposed at ground floor level. The heights above ground level (1.5m) shown in Table 4 below represent the height of the lowest residential dwelling in that specific location of the Proposed Development (5 - 8.5m).

Table 4: Receptor Locations

Receptor ID	Location	NGR		Z (m)
		X	Y	
R01a, b	Proposed Receptor	471705	173170	15, 8.5
R02a, b	Proposed Receptor	471726	173188	15, 8.5
R03a, b	Proposed Receptor	471745	173204	15, 8.5
R04a, b	Proposed Receptor	471754	173219	15, 5.0
R05a, b	Proposed Receptor	471763	173234	15, 5.0

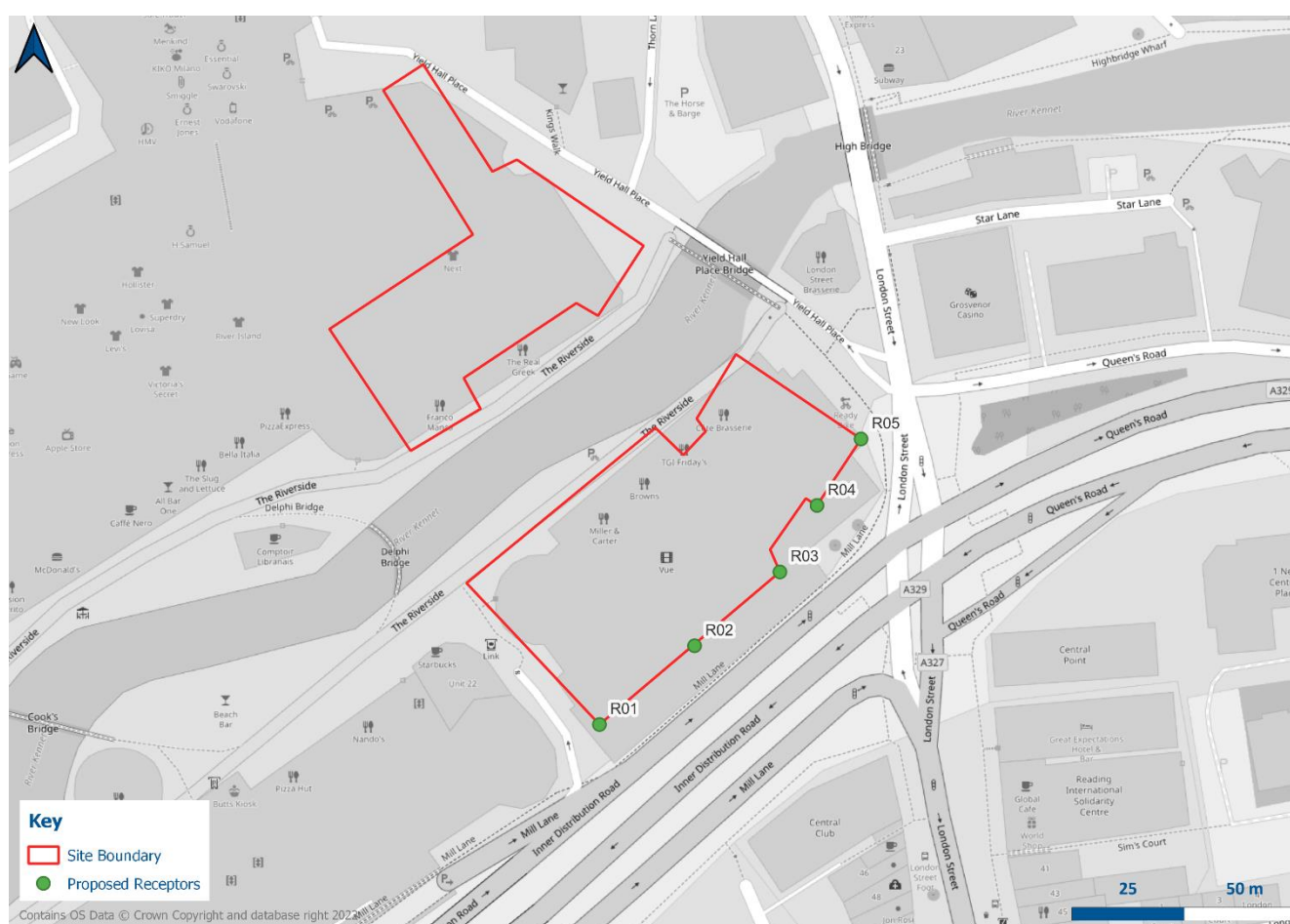


Figure 4: Receptor Locations

3.5.5.2 Ecological Receptors

The area surrounding the Site was assessed for the designations listed below, The MAGIC website, which incorporates Natural England's interactive maps²³:

- » Special Protection Areas (SPAs)
- » Special Areas of Conservation (SACs)
- » Ramsar sites (protected wetlands)
- » Sites of Special Scientific Interest (SSSIs)

- » Local nature sites (ancient woods, local wildlife sites and national and local nature reserves)

There are no ecological sites that are expected to be affected by the Proposed Development.

3.5.6 Model Verification

A verification study has been undertaken in accordance with LAQM.TG(22) using LA monitoring data. An adjustment factor of **1.13** was applied to modelled road NO_x concentrations.

Due to insufficient PM monitoring in the study area, the modelled road-PM₁₀ and road-PM_{2.5} components have been adjusted by the NO_x verification factor obtained before adding to the appropriate background concentration, in accordance with LAQM.TG(22). This approach is considered likely to provide a conservative estimate of the contribution of modelled roads to ambient PM₁₀ and PM_{2.5} concentrations.

Root Mean Square Error (RMSE) is used to define the average error or uncertainty of the model. LAQM.TG(22) states that the RMSE is acceptable where it is within 25%. The model verification process calculated a post-adjusted RMSE of **2.6µg/m³**, which equates to **6.6%** of the annual mean AQS objective for NO₂ and is therefore considered to be acceptable.

Full details of the model verification procedure are included in Appendix C.

3.5.7 NO_x to NO₂ Conversion

Ambient NO_x concentrations have been predicted through dispersion modelling. Annual NO_x concentrations have been converted using Defra's NO_x to NO₂ conversion tool²⁹ version 8.1.

3.6 Comparison with Air Quality Criteria

3.6.1 Nitrogen Dioxide

Dispersion model annual mean road NO_x was converted to annual mean NO₂ using the Defra calculator. To determine short term (1 hour mean) concentrations, reference was made to LAQM.TG(22)⁹, which states if annual mean concentrations of NO₂ do not exceed 60µg/m³, it is unlikely hourly mean concentrations would exceed the relevant objective, which allows for 18 exceedances of the hourly standard (200µg/m³) in a calendar year.

3.6.2 Particulate Matter

To determine total annual mean concentrations of PM₁₀ and PM_{2.5} at receptors, the modelled road contribution is added to the background concentration to give the total concentration for comparison with the annual mean criterion.

Annual mean PM₁₀ concentrations are then used to derive the number of exceedances of the 24-hour mean PM₁₀ criterion, of which 35 are allowed per year. The method described in Defra's Technical Guidance LAQM.TG(22) was applied, which is based on the relationship between the number of 24-hour exceedances of 50µg/m³ and the annual mean concentration. This relationship is described in Equation 1 below:

Equation 1 - Calculation of PM₁₀ 24-hour Mean Exceedances

Number of exceedances of 24-hour mean of 50µg/m³ = $-18.5 + 0.00145 \cdot a^3 + (206/a)$

where 'a' = total annual mean PM₁₀ concentration.

²⁹ Defra, "NO_x to NO₂ Calculator" (Defra, 2019), <https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc>.

3.7 Assessment of Significance

The long-term annual average for NO₂, PM₁₀ and PM_{2.5} have been compared against the applicable AQALs and the magnitude of impacts has been determined against the following threshold criteria, from the EPUK & IAQM guidance.

Table 5: Impact Significance Criteria

Long term average concentration at receptor in assessment year	% Change in concentration relative to AQAL			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76 - 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 - 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 - 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Notes:

In accordance with EPUK & IAQM planning guidance any change less than 0.5% will be considered as Negligible. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5%, will be described as Negligible.

With regard to the exposure assessment, professional judgement has been applied to determine whether exposure to air pollution is significant or not, based on the following criteria:

- » Annual mean concentrations within 10% below or exceeding relevant AQAL = significant exposure;
- » Annual mean concentrations more than 10% below relevant AQAL = not significant.

The 10% threshold around an AQAL is generally considered to be the range at which a 'risk of exceedance' is present, according to LAQM.TG(22).

3.8 Model Limitations

There are inherent uncertainties associated with the model (ADMS Urban) used in this assessment, including the uncertainties associated with the input data such as predicted traffic flows. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS model will not take into account.

To account for uncertainty in future emission factors and pollutant concentrations, a sensitivity test has been undertaken in the assessment, whereby:

- » Emission Factors held at 2019 (no future improvements assumed);
- » Background pollutant concentrations held at 2019 (no future improvements assumed)

The above assumptions ensure a conservative approach has been considered in the assessment.

4. Baseline Air Quality Conditions

4.1 Local Air Quality Management

The Site is located within the Reading AQMA, which covers Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4) and along the railway lines where they pass through built-up areas. The AQMA was declared by RBC in 2009 for exceedance of the annual mean AQS Objective for NO₂. The RBC Air Quality Action Plan Update³⁰ (2016) details the actions, policies and priority measures being taken by RBC to improve local air quality in the AQMA.

4.2 Local Emission Sources

The main source of air pollution in the surrounding Site locale are vehicles using the local road network, predominantly the A329 and A327 to the south.

A review of the NAEI¹⁸, EA¹⁹ and Defra's PRTR²⁰ data indicates that there are no major industrial pollution sources in the immediate vicinity of the Site that will influence local air quality.

4.3 Defra Mapped Concentrations

4.3.1 Background Concentrations

Mapped background concentrations of NO₂, PM₁₀ and PM_{2.5} were downloaded for the grid squares containing the Site.

Background pollutant concentrations for 2019 (the base year) and 2025 (the earliest opening year of the Proposed Development) are displayed in Table 6.

To avoid double counting of potential source contributions already contained within the ADMS-Roads dispersion model, 'Primary A Road in' was removed from each grid square. As the relationship between NO₂ and NO_x is not linear, the NO₂ Adjustment for NO_x Sector Removal Tool³¹ has been used – in accordance with LAQM.TG(22).

Table 6: Adjusted Defra Mapped Background Concentrations

Grid Square (x,y)	Pollutant	AQAL (µg/m ³)	Annual Mean Concentration (µg/m ³)	
			2019	2025
471500, 173500	NO ₂	40	32.2	29.0
	PM ₁₀	40	18.8	17.0
	PM _{2.5}	20	13.5	11.9
471500, 172500	NO ₂	40	19	16.3
	PM ₁₀	40	17.8	16.5
	PM _{2.5}	20	12.5	11.5
472500, 173500	NO ₂	40	22.4	19.3
	PM ₁₀	40	17.2	15.9

³⁰ https://images.reading.gov.uk/2020/01/AQAP_Update_2016.pdf

³¹ Defra NO₂ Adjustment for NO_x Sector Removal Tool version 7.0 (2018), available at <https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector>.

Grid Square (x,y)	Pollutant	AQAL ($\mu\text{g}/\text{m}^3$)	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)	
			2019	2025
	PM _{2.5}	20	12.0	10.9

The data show that annual mean background concentrations of NO₂, PM₁₀ and PM_{2.5} within the Site locale are below the AQALs in all years.

Concentrations of all pollutants are predicted to decline incrementally each year. These reductions are principally due to the forecast effect of the roll out of cleaner vehicles and strategies to reduce emissions across all sectors.

Defra UK-AIR modelled background concentrations for relevant grid squares were considered to be the appropriate source of background concentrations in the dispersion model for the assessment of human health receptors. NO₂, PM₁₀ and PM_{2.5} backgrounds were derived from this data shown above.

Background concentrations for each modelled receptor location are shown in Appendix D.

4.3.2 Pollution Climate Mapping

Defra's PCM model provides estimates of roadside concentrations of annual mean NO₂, which are used in reporting compliance with limit values. The model provides projected roadside concentrations of pollutants, for the years 2018-2030 inclusive, based on a 2018 base year.

The A329 has been included as PCM model links as illustrated in Figure 4. Roadside annual mean NO₂ concentrations are projected to be 35 $\mu\text{g}/\text{m}^3$ and therefore below the annual mean AQAL.

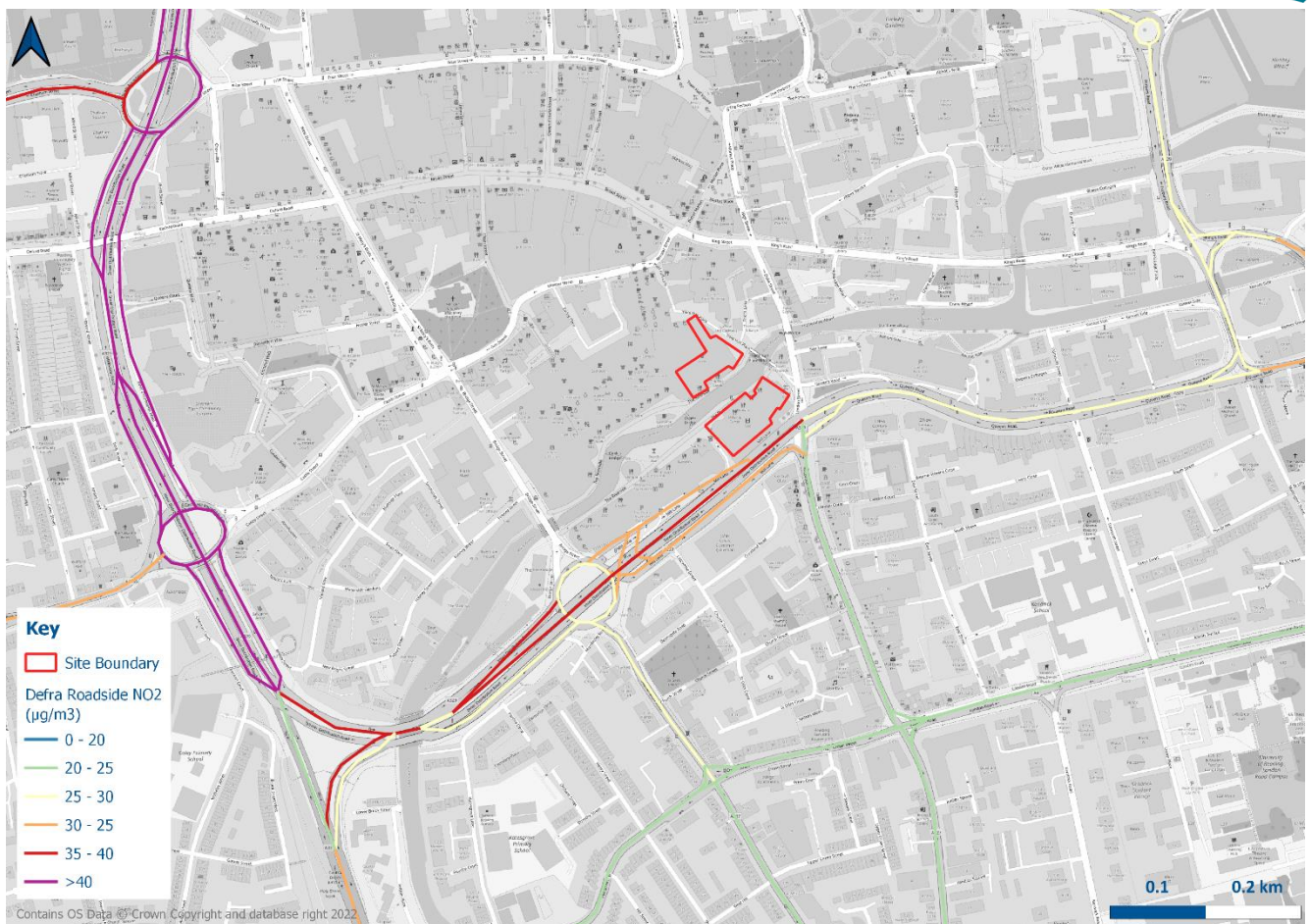


Figure 5: Defra Modelled PCM Roadside NO₂ Concentrations

4.4 Air Quality Monitoring Data

4.4.1 Automatic Monitoring

The UK Automatic Urban and Rural Network (AURN) is a countrywide network of air quality monitoring stations operated on behalf of the Defra. Monitoring data for AURN sites is available from the UK Air website³².

The closest AURN monitor to the Site is the Reading New Town AURN (NGR: x473468, y173207) located approximately 1.7km east from the Site. Given the distance between the Reading New Town AURN and the Site, monitored concentrations at the AURN monitor are not considered to be representative of the Site. Therefore, monitoring data from the Reading New Town AURN has not been considered in this assessment.

The Local Authority undertakes continuous air quality monitoring at 3 locations within the Council's area. The closest of these continuous air quality monitors to the Site is Caversham Road (RD1) situated approximately 1.2km north. Due to the distance, monitoring data has not been presented as the analyser is not considered to be representative of the Site.

³² Automatic Urban and Rural Network (AURN) - Defra, UK

4.4.2 Passive Monitoring

Passive diffusion tube monitoring is currently undertaken by RBC at numerous locations throughout the Council's area as part of their commitment to LAQM. The closest tubes to the Site are shown in Figure 6 and the data presented in Table 7.

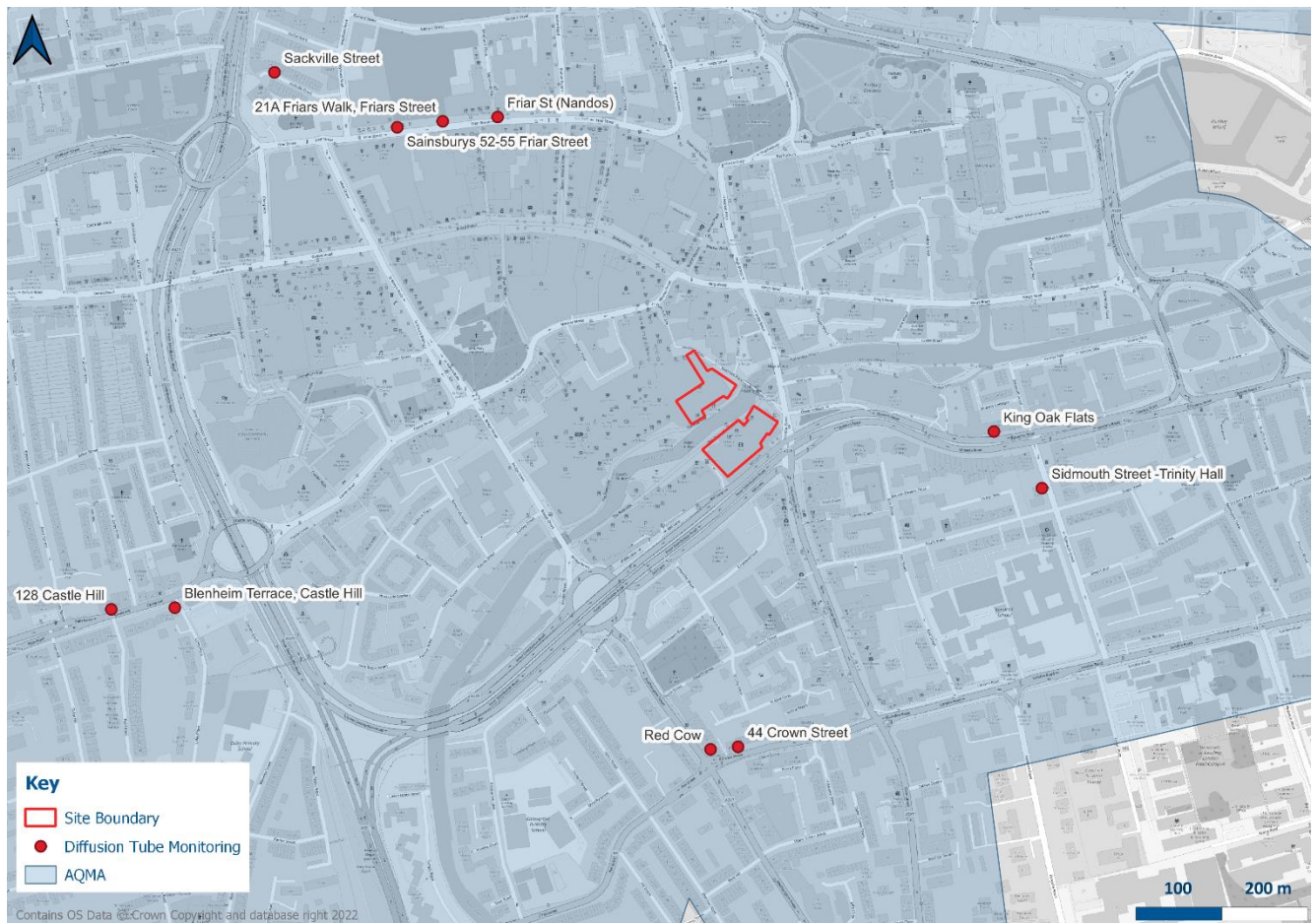


Figure 6: Local Authority Monitoring

Table 7: Passive Diffusion Tube Monitoring Concentrations

Site Name	Site Type	X (m)	Y (m)	Distance from Site (m)	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)			
					2016	2017	2018	2019
King Oak Flats	UC	472015	173223	250 - E	33	31	32	28
Sidmouth Street - Trinity Hall	R	472071	173157	315 - SE	-	-	37	34
Red Cow	R	471685	172853	315 - S	38	35	38	31
44 Crown Street	R	471717	172856	310 - S	37	35	34	29
Friar Street (Nandos)	K	471437	173589	360 - NW	52	50	42	41
21a Friars Walk	R	471373	173584	435 - NW	-	-	-	39

Site Name	Site Type	X (m)	Y (m)	Distance from Site (m)	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)			
					2016	2017	2018	2019
Sainsburys 52-55 Friar Street	R	471320	173577	400 - NW	-	-	-	40
Sackville Street	R	471177	173641	590 - NW	37	37	38	32
Blenheim Terrace, Castle Hill	R	471061	173018	635 - W	39	39	33	34
128 Castle Hill	R	470987	173016	700 - W	45	46	42	39

Notes:

R = Roadside, K = Kerbside, UC = Urban Centre

The data in Table 7 shows there have been exceedances of the NO₂ annual mean AQAL at monitoring sites along Friar Street and Castle Hill. Measured concentrations at Sidmouth Street, Red Cow and Sackville Street have also been within 10% of the annual mean AQAL and therefore in accordance with LAQM.TG(22) there is a risk of exceedance.

The diffusion tube closest to the Site (King Oak Flats) and considered most representative of Site conditions, shows that annual mean NO₂ concentrations are below the AQAL in recent years.

5. Construction Phase Assessment

5.1 Overview

The construction phase of the Proposed Development will involve a number of activities that will release polluting emissions to air. Predominantly, these will be emissions of dust. As such, a qualitative construction dust risk assessment has been carried out in accordance with IAQM guidance. Where detailed information was unknown, the dust emission magnitude has been calculated based on educated assumptions.

Construction activities will include:

- » material export and import;
- » temporary stockpiling of materials;
- » groundwork for foundations and services;
- » construction of buildings;
- » landscaping works; and
- » vehicle movements (with the potential to track-out material from site).

The risks of impact and the significance of each stage of the construction phase is classified as Negligible, Low, Medium or High, determined against a matrix which considers the distance from source, receptor sensitivity, background pollution concentrations and the potential dust emission magnitude of the works.

5.2 Construction Traffic Emissions

The IAQM guidance states that from experience of assessing exhaust emissions from site traffic, it is unlikely that any significant adverse impacts on local air quality would be caused and in the vast majority of cases, quantitative assessment is not needed. As such, short term effects of construction traffic emissions have not been assessed, as they are also likely to be well below the EPUK & IAQM traffic criteria outlined in Table 3.

5.3 Dust Emission Magnitude

5.3.1 Demolition

The existing Vue building will be completely demolished and the Debenhams building will be partially demolished as part of the development proposals. The total building volume to be demolished is estimated to be >50,000m³ with construction materials comprising concrete, brick and steel. Demolition activities will take place up to 20m above ground level.

Based on the above, the potential dust emission magnitude for demolition is considered to be '**Large**'.

5.3.2 Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping. The total area of the Site is within the IAQM's 'Medium' criteria (2,500m² - 10,000m²). The underlying soil texture is loamy³³ which have a medium potential for dust release when due to the smaller particle size.

Based on the above, the potential dust emission magnitude for earthworks is considered to be '**Medium**'.

³³ Cranfield University, "Cranfield Soil and Agrifood Institute," n.d., <http://www.landis.org.uk/soilscapes/>.

5.3.3 Construction

The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials, and duration of build. An estimation of the total volume of buildings to be constructed (i.e., extensions) has been estimated based on the masterplan of the Proposed Development.

The total volume of buildings to be constructed was estimated to be >100,000m³, with construction materials comprising masonry, concrete and glass. It has been assumed that concrete batching and sandblasting will not be undertaken onsite.

Based on the above, the potential dust emission magnitude for construction is considered to be '**Large**'.

5.3.4 Trackout

The risk of impacts occurring during Trackout is predominantly dependent on the number of vehicles accessing the Site on a daily basis. However, vehicle size, speed and the duration of activities are also factors which are used to determine the risk of impacts.

It is expected that there would be no more than 50 HDVs outwards movements from the Site each day. No unpaved surfaces over 50m would be utilised as site traffic would be routed along the existing road network.

Based on the above, the potential dust emission magnitude during Trackout is considered to be '**Medium**'.

5.3.5 Summary

Table 8 below shows a summary of the potential dust emission magnitudes from each activity.

Table 8: Dust Emission Magnitude Summary

Activity	Dust Emission Magnitude
Demolition	Large
Earthworks	Medium
Construction	Large
Trackout	Medium

5.4 Sensitivity of Area

The prevailing wind direction for the closest regionally representative meteorological measurement station to the Site, at Farnborough, is shown below for 2019 in Appendix C. The wind rose shows that the prevailing winds are from the south-west. Sensitivity of the area is based on IAQM guidance.

Figure 7 shows the construction phase distance buffers (20m, 50m, 100m and 350m) for the Site boundary, as well as identified high sensitivity receptor locations within these buffers.

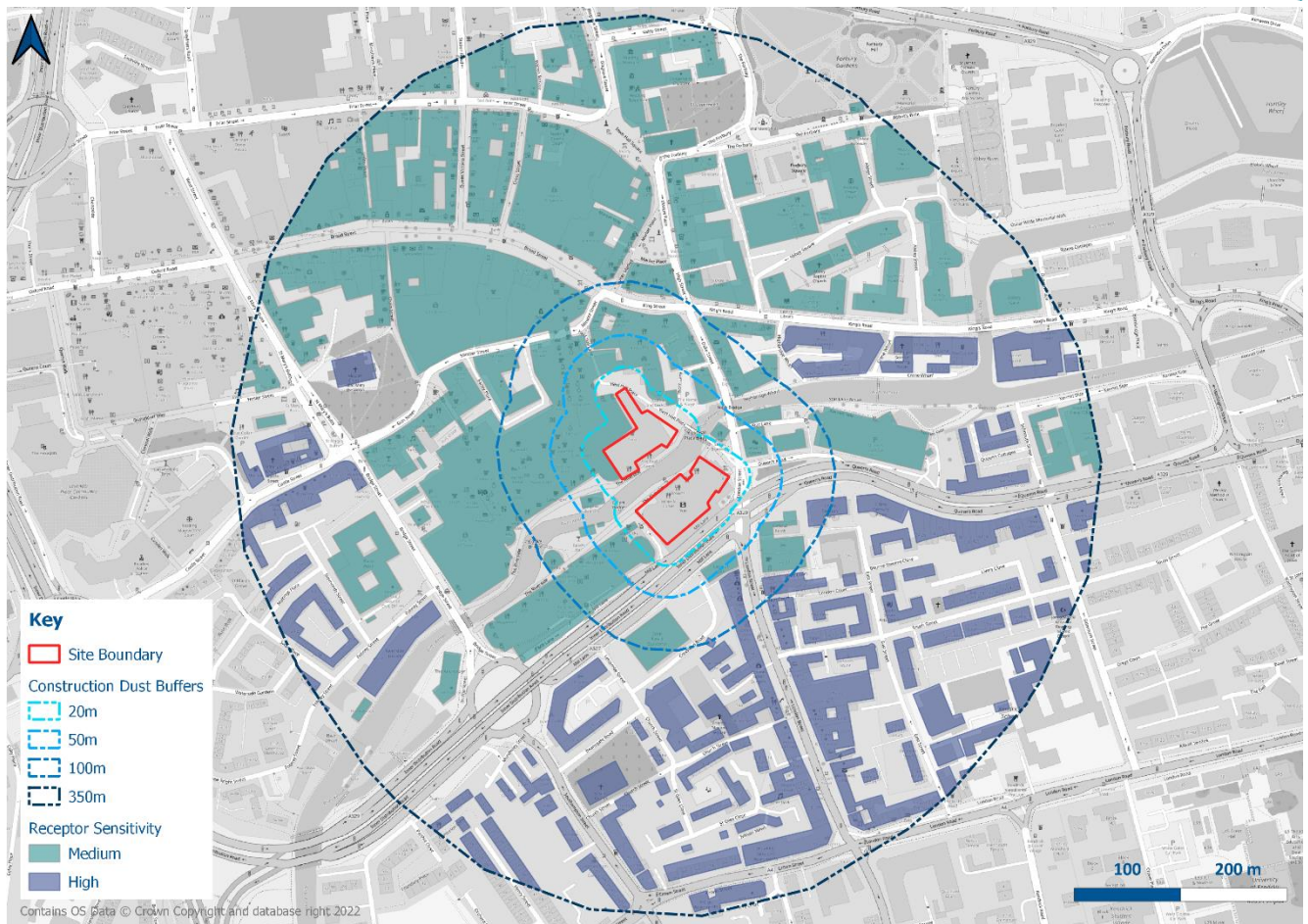


Figure 7: Construction Phase Receptors

5.4.1 Dust Soiling Impacts

As shown in Figure 7, there are more than 10 medium sensitivity human receptors within 20m of the Site boundary. As such, the overall sensitivity of the surrounding area to nuisance dust soiling effects during Earthworks and Construction, according to IAQM guidance, is defined as '**Medium**'.

With regard to Trackout, the sensitivity for Medium size sites is assessed where receptors are located within 50m from Trackout routes up to 200m from the Site. As there are more than 10 high-sensitivity receptors within 20m of potential Trackout routes from the Site, the sensitivity to dust soiling impacts from Trackout is defined as '**High**'.

5.4.2 Human Health Impacts

Defra mapped background predictions (Table 6) show that annual mean concentrations of PM₁₀ are not likely to exceed 24µg/m³ in the vicinity of the Site³⁴, based on 2019 estimates. According to IAQM guidance, where PM₁₀ concentrations are <24µg/m³ and there are less than 100 high sensitivity receptors within 20m of construction works, the overall sensitivity of the surrounding area to human health impacts is defined as 'Low' for Demolition, Earthworks, Construction and Trackout.

³⁴ the concentration at which exceedance of the 24-hour AQAL is likely

5.4.3 Summary

The sensitivity of the surrounding area for the potential impacts discussed above are shown in Table 9 below.

Table 9: Sensitivity of Local Area

Potential Impact	Sensitivity of Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	High
Human Health	Low	Low	Low	Low

5.5 Risk of Impacts

Using the methodology prescribed in the IAQM guidance, the overall risk of impacts can be defined by combining the sensitivity of the area with the potential dust emission magnitude of each stage of the construction phase as described above.

Table 10 provides a summary of the construction dust risk assessment. Overall, the development is considered to be **High Risk** for nuisance dust soiling effects and a **Medium Risk** for PM₁₀ health effects, in the absence of mitigation.

Table 10: Risk of Adverse Impacts During Construction Phase

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High Risk	Medium Risk	Medium Risk	Medium Risk
Human Health	Medium Risk	Low Risk	Low Risk	Low Risk

6. Operational Phase Assessment

6.1 Occupant Exposure

Modelled annual mean NO₂, PM₁₀ and PM_{2.5} concentrations at locations of relevant exposure within the Site boundary are shown in Table 11. The modelling scenario utilised 2025 emission factors and background concentrations to represent the proposed opening year (2025).

Table 11: Model Predicted Annual Mean Concentrations for 2025

Receptor	NO ₂ Concentration (µg/m ³)	% of AQAL	PM ₁₀ Concentration (µg/m ³)	% of AQAL	PM _{2.5} Concentration (µg/m ³)	% of AQAL
R01a	34.7	87	18.2	46	12.6	63
R02a	33.8	85	18.1	45	12.5	63
R03a	33.5	84	18.0	45	12.5	63
R04a	32.6	82	17.8	45	12.4	62
R05a	32.1	80	17.7	44	12.3	62
R01b	32.9	82	17.7	44	12.3	61
R02b	31.9	80	17.5	44	12.2	61
R03b	31.5	79	17.5	44	12.2	61
R04b	32.0	80	17.7	44	12.3	61
R05b	31.7	79	17.6	44	12.2	61

Figure 8, Figure 9 and Figure 10 illustrate ground level (1.5m) modelled concentrations of annual mean NO₂, PM₁₀ and PM_{2.5} concentrations across the Site.

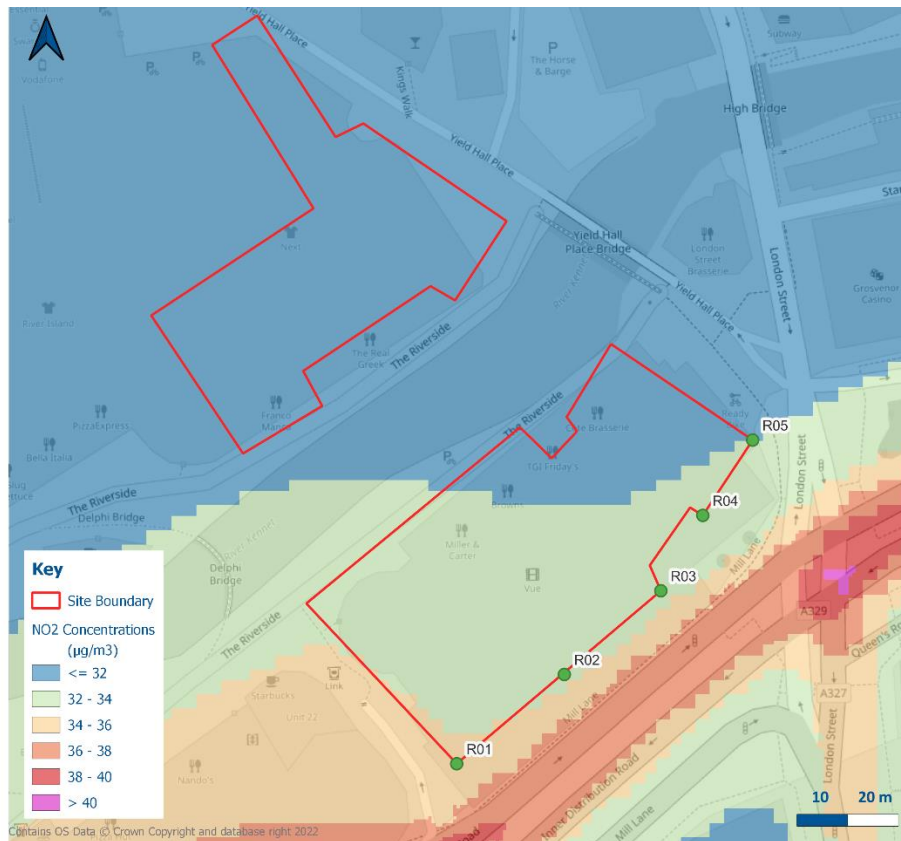


Figure 8: Modelled NO₂ Concentrations at the Site

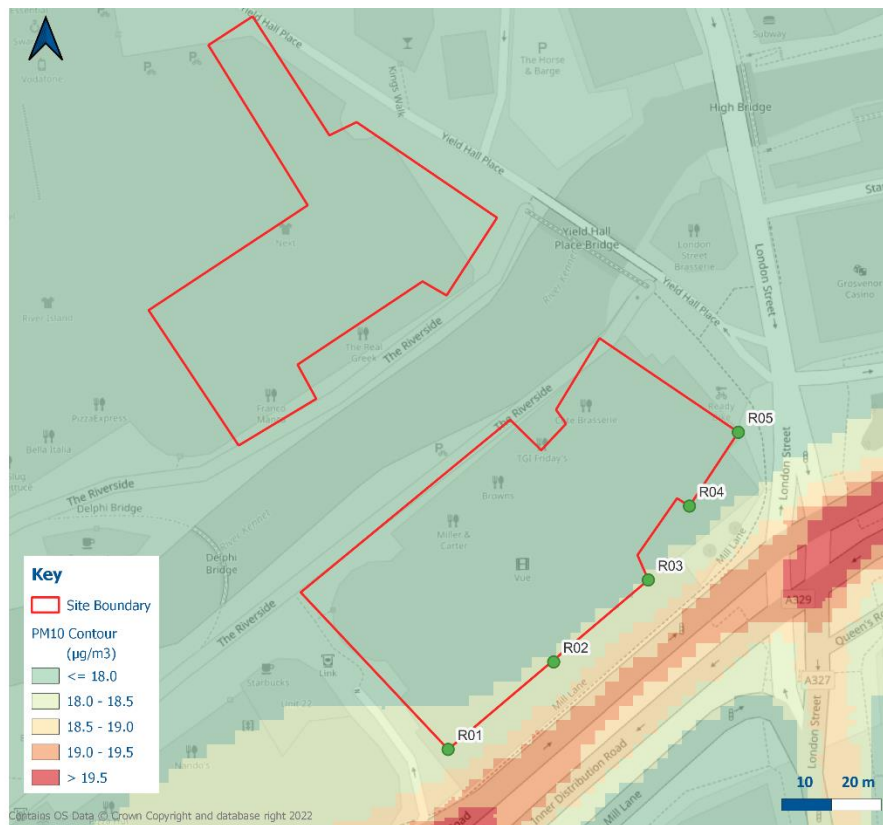


Figure 9: Modelled PM₁₀ Concentrations at the Site

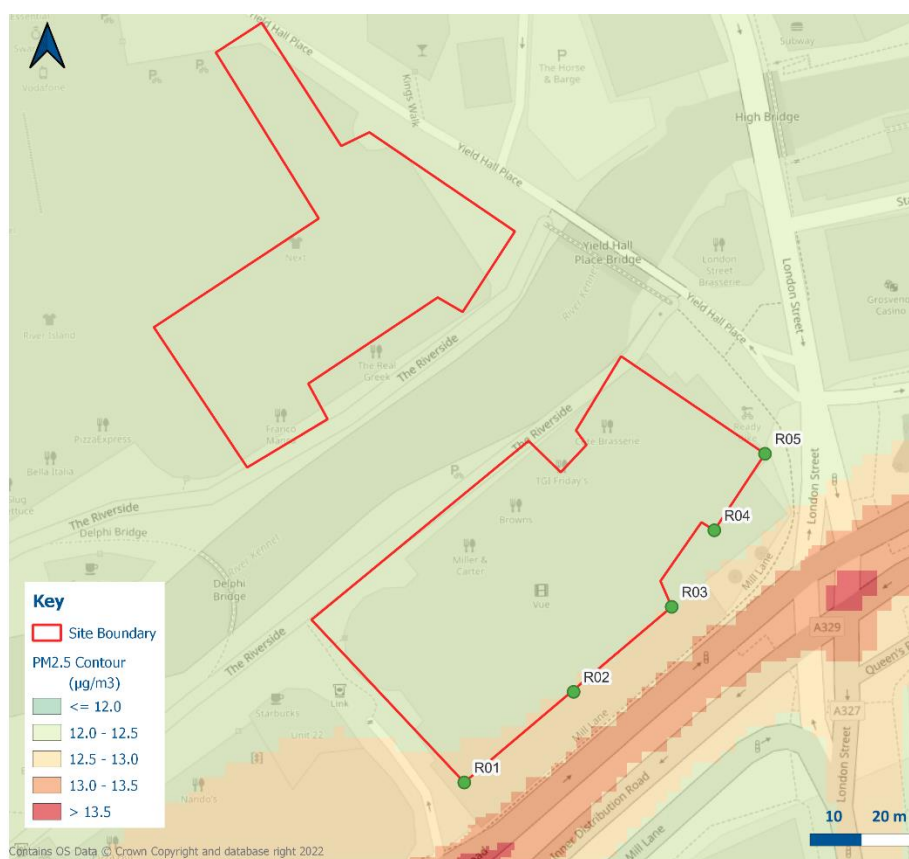


Figure 10: Modelled PM_{2.5} Concentrations at the Site

Table 11 and Figures 8-10 indicate modelled concentrations of NO₂, PM₁₀ and PM_{2.5} are below the relevant annual mean AQALs across the Site. Furthermore, annual mean NO₂ concentrations are below 60µg/m³ and therefore exceedances of the 1 hour mean NO₂ AQAL are unlikely to occur. There were also no predicted exceedances of the 24-hour mean AQAL at any of the receptors included in the dispersion model.

6.2 Significance of Air Quality Impacts

The EPUK & IAQM guidance considers a number of factors for the determination of significance of predicted air quality impacts. Such factors include:

- » the existing and future air quality in the absence of the development;
- » the extent of current and future population exposure to the impacts;
- » the worst-case assumptions adopted when undertaking the prediction of impacts; and
- » the extent to which the development has adopted best practice to eliminate and minimise emissions.

The unmitigated impact associated with the scheme has been predicted in accordance with the stated assessment methodology. The following factors have been taken into account:

- » there are no predicted exceedances of the annual mean NO₂, PM₁₀ or PM_{2.5} AQALs as a result of the Proposed Development;
- » a negligible impact on annual mean NO₂, PM₁₀ or PM_{2.5} concentrations has been predicted;
- » the Proposed Development will not introduce any new receptors into an area of exceedance of any relevant AQAL, including at new receptor locations of relevant exposure introduced within the Site;
- » exceedances of the 1-hour mean NO₂ and 24-hour mean PM₁₀ AQALs are considered unlikely, based upon the absolute concentrations predicted through the dispersion modelling study; and
- » all modelled concentrations have been verified against RBC monitoring data.

A sensitivity assessment of the model input variables (emission factors and background concentrations) has been considered and is presented in Appendix E. However, the overall conclusion over the significance of the effect has been based upon the main body of the assessment, utilising 2025 as the development opening year. Notwithstanding, it is noted that the sensitivity assessment presented within Appendix E does predict exceedances of the NO₂ annual mean AQAL at ground floor level within the Site boundary. However, there are no high sensitivity uses at ground floor level and therefore the annual mean AQAL does not apply.

Modelled annual mean NO₂ concentrations at the façade of the lowest residential dwellings within Yield Place 2 fronting the A329 are within 10% of the AQAL and therefore, in accordance with LAQM.TG(22) are at risk of exceedance. It is worth reiterating that the sensitivity test represents a highly conservative scenario and as shown by RBC monitoring, NO₂ across the city is showing a general downward trend²⁴. Therefore, the modelled concentrations within the sensitivity analysis are likely to be higher than those anticipated within the proposed opening year.

7. Mitigation Measures

7.1 Construction Phase

The qualitative construction dust risk assessment shows that the works are **Medium Risk** for adverse impacts during construction, in the absence of mitigation.

To effectively reduce the risk of impacts to Negligible, appropriate mitigation measures should be adopted. The IAQM's highly recommended mitigation measures for Medium-Risk sites are provided at Appendix F of this report. Implementing these measures, such as within a Construction Environment Management Plan (CEMP), should effectively reduce the risk of impacts to negligible during the construction phase.

7.2 Operational Phase

7.2.1 Travel Plan Measures

As detailed in the Travel Plan (TP)³⁵ prepared by Stantec, the Site is located in an accessible location in Reading and is well located to make use of the existing public transport links and pedestrian / cycle routes. Furthermore, the measures outlined in the TP will seek to encourage sustainable modes of transport and discourage the use of car travel, such as;

- » Review, improve and update travel information on transport web pages;
- » Welcome travel information packs with the above information to residents prior to moving into units;
- » Initiatives to promote walking and cycling;
- » Initiatives to promote public transport;
- » Initiatives to promote car sharing; and
- » Promote lift-sharing taxi services;

These measures provide an opportunity to promote and establish sustainable modes of transport which will help to reduce potential air quality impacts.

³⁵ Yield Hall Place 1 & 2, Reading Travel Plan, Stantec November 2022

8. Discussion and Conclusion

Hydrock were commissioned by The Oracle Partnership Ltd to prepare an AQA for the mixed-use development at the former Debenhams and Vue within The Oracle, Reading.

A qualitative construction dust risk assessment has been undertaken in line with IAQM guidance. Through good practice and implementation of appropriate mitigation measures outlined, it is expected that the release of dust would be effectively controlled and mitigated, with resulting effects considered to be 'not significant'. All dust impacts are considered to be temporary and short-term in nature.

A qualitative operational phase assessment has been undertaken by following screening criteria provided in EPUK & IAQM guidance. There will be no material change in the quantum of traffic generated by the Proposed Development as it will be car free; therefore, movements are below the relevant EPUK & IAQM guidance criteria and as such, it is not anticipated that any significant adverse impacts on local air quality will occur and the Proposed Development is considered to be compliant with the NPPF and local Planning Policies.

A site suitability assessment has been produced due to the location of the Site, within an AQMA. The emissions generated from traffic travelling along nearby roads were modelled for NO₂, PM₁₀ and PM_{2.5} using the latest version of ADMS-Urban (version 5.1). The results of this exposure modelling demonstrated that, there are not predicted to be any exceedances of the AQAL at locations of relevant exposure at the Proposed Development. As such, the overall effect arising from change in operational phase trips is considered to be 'not significant'.

From the evidence presented, and by following the guidance provided herein, the Proposed Development will comply with all relevant air quality policy. As such, air quality should not pose any significant obstacles to the planning process.

Appendix A Traffic Data

The traffic data used in the assessment is shown in below in Table 12. Data was provided for the following scenarios:

- » 2019 Baseline / Verification
- » 2025 Opening Year.

Table 12: Traffic Data

Link ID	Road Link	Model Verification		2025 oy	
		AADT	% HDV	AADT	% HDV
L01	A329	13608	2.4%	14631	2.4%
L02	Queens Road (A329)	19688	1.8%	21169	1.8%
L03	Mill Lane (North A329)	5301	1.5%	5700	1.5%
L04	A327	6477	9.4%	6964	9.4%
L05	Crown Street	10844	1.3%	11659	1.3%
L06	A4 London Street	12680	4.1%	13634	4.1%
L07	Southampton Street (A327)	7365	3.6%	7919	3.6%
L08	A327 (North of Crown Street)	17151	3.8%	18441	3.8%
L09	Pell Street	7198	1.6%	7739	1.6%

Appendix B Windrose

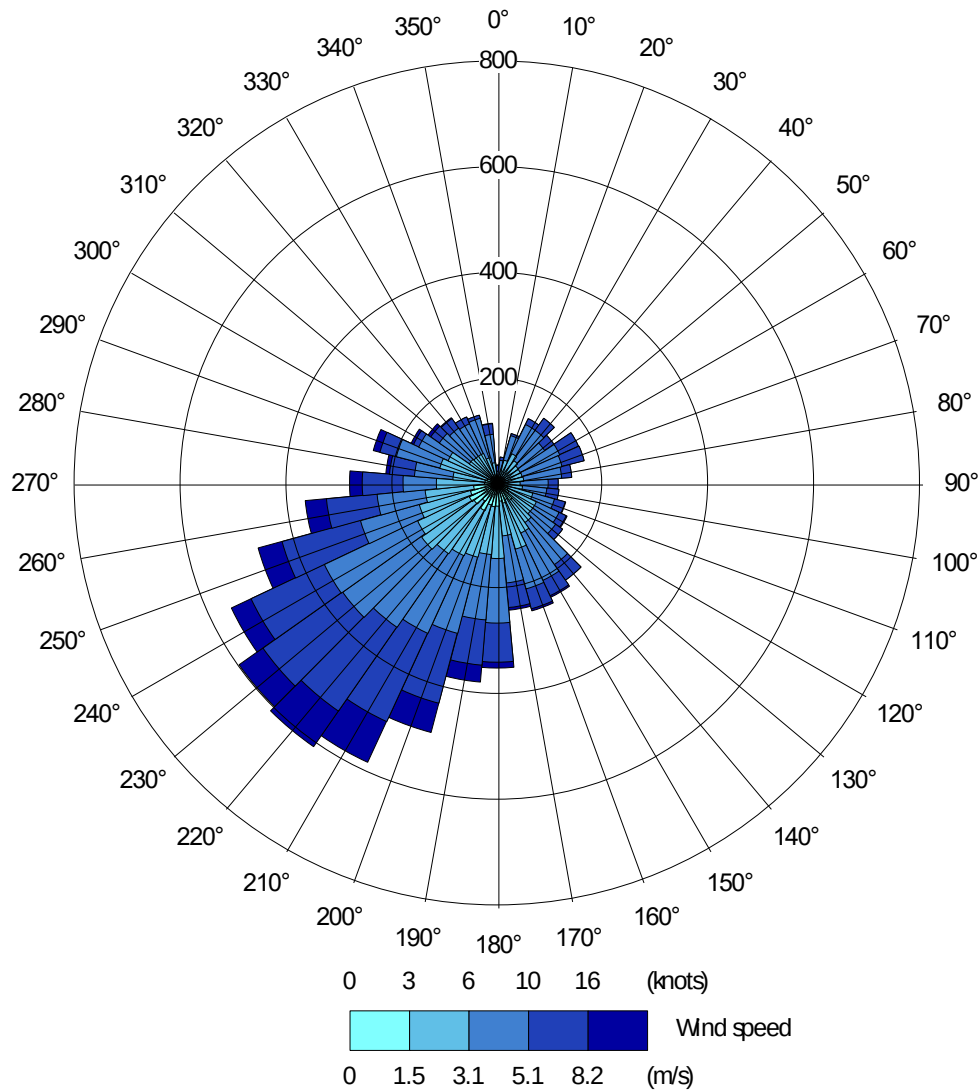


Figure 11: Wind rose Farnborough (2019)

Appendix C Model Verification

An important stage in the modelling process is model verification, which involves comparing the model output with measured concentrations in order to increase confidence in modelled predictions.

According to LAQM.TG (22), the difference between modelled results and monitored concentrations is acceptable where it is within 25%.

Monitoring Locations used for Verification

The following monitoring locations were selected for model verification due to being representative of the study area and having more than 75% data collection for 2019:

- 44 Crown Street;
- Red Cow and
- King Oak Flats

Model Verification

It is most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$). The model output of road- NO_x (i.e., the component of total NO_x coming from road traffic) has been compared with the 'measured' road- NO_x . Measured road- NO_x has been calculated from the measured NO_2 concentrations using the NO_x from NO_2 calculator (Version 8.1) available on the Defra LAQM Support website²⁹.

A comparison of modelled and monitored concentrations prior to adjustment are given in Table 13.

Table 13: 2019 Modelled and Monitored Concentrations Before Adjustment

Monitoring ID	Modelled Road NO_x (m^3/m^3)	Monitored Road NO_x ($\mu\text{g}/\text{m}^3$)	Ratio Monitored/Modelled	Modelled Total NO_2 ($\mu\text{g}/\text{m}^3$)	Monitored Total NO_2 ($\mu\text{g}/\text{m}^3$)	Difference (%)
44 Crown Street	12.4	19.6	1.6	25.4	29	-12
Red Cow	19.8	23.7	1.2	29.1	31	-6
King Oak Flats	13.7	8.2	0.6	30.7	28	10

As shown, the model was underpredicting at two of the three tubes. As a conservative approach, an adjustment factor of **1.13** has been determined, as the equation of the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution of NO_x , as shown below:

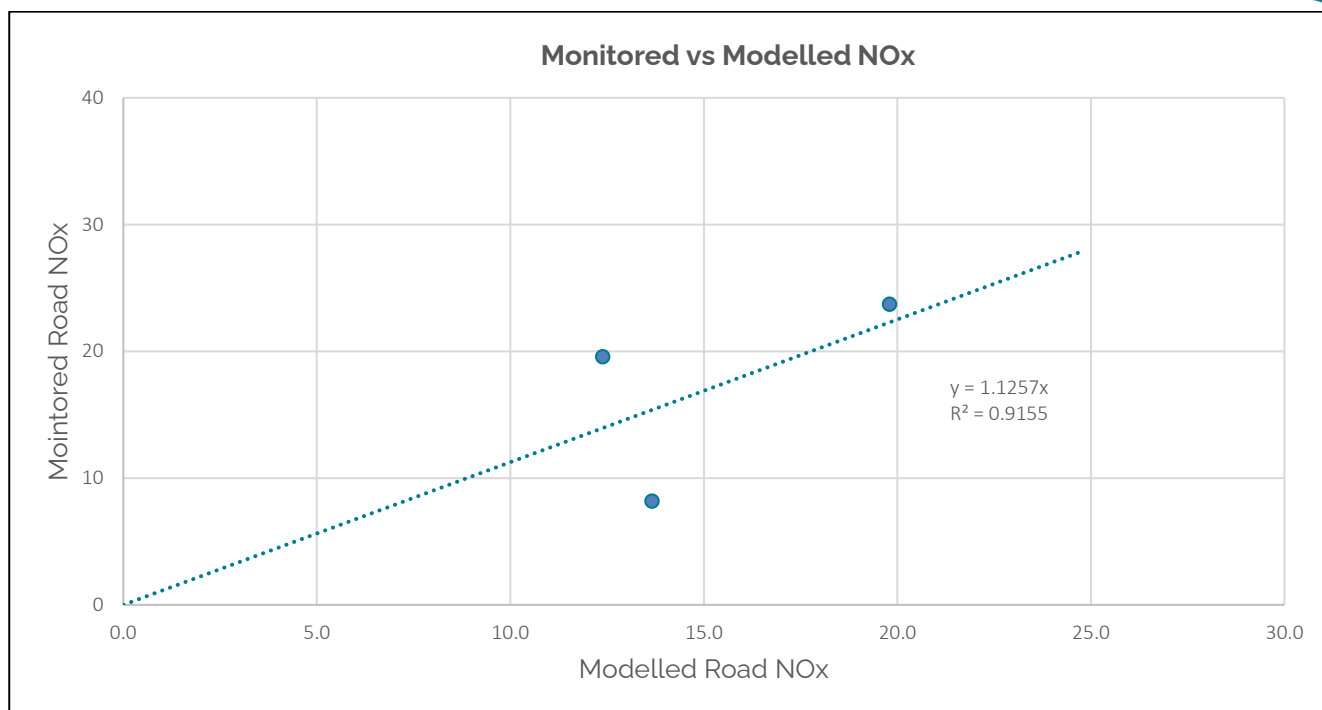


Figure 12: Model Adjustment Factor

Table 14 shows total monitored versus modelled NO₂ following the adjustment of the road contribution of NO_x by this factor. The total NO₂ concentration was determined by adding the calculated background NO₂ concentration to the modelled road contribution.

Table 14: Post-adjusted 2019 Modelled and monitored results

Monitoring ID	Adjusted Modelled NO ₂ (µg/m ³)	Monitored NO ₂ (µg/m ³)	Difference (%)
44 Crown Street	26.2	29	-10%
Red Cow	30.3	31	-2%
King Oak Flats	31.6	28	13%

Following adjustment of NO_x by a factor of **1.13**, modelled concentrations of NO₂ were within the accepted +/-25% range of monitored concentrations:

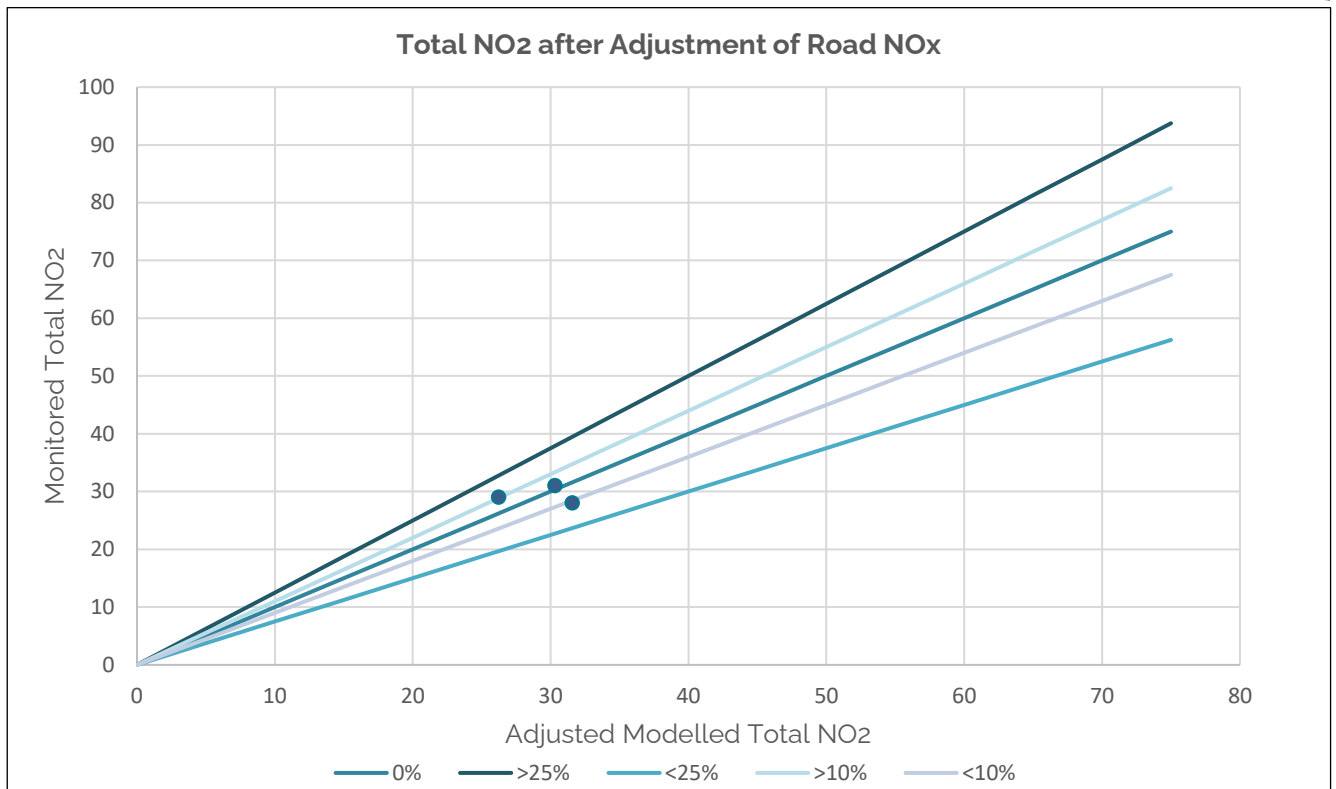


Figure 13: Post-adjusted Monitored vs Modelled NO₂

In addition, the overall post-adjusted uncertainty (RMSE) for annual mean NO₂ was 6.6%, which is well within ideal 10% range of uncertainty. As such, the factor was considered to be acceptable.

As there is insufficient PM₁₀ or PM_{2.5} monitoring data in the study area, it was not possible to perform model verification for these pollutants. As such, the NO₂ adjustment factor has also been applied to PM₁₀ and PM_{2.5} model results, in accordance with LAQM.TG(22).

Appendix D Background Concentrations

The background concentrations used in the modelling assessment are shown below.

Table 15: Adjusted Background Concentrations

Receptor	Year	X	Y	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
R01a	2019	471500	173500	32.2	18.8	13.5
R02a	2019	471500	173500	32.2	18.8	13.5
R03a	2019	471500	173500	32.2	18.8	13.5
R04a	2019	471500	173500	32.2	18.8	13.5
R05a	2019	471500	173500	32.2	18.8	13.5
R01b	2019	471500	173500	32.2	18.8	13.5
R02b	2019	471500	173500	32.2	18.8	13.5
R03b	2019	471500	173500	32.2	18.8	13.5
R04b	2019	471500	173500	32.2	18.8	13.5
R05b	2019	471500	173500	32.2	18.8	13.5
R01a	2025	471500	173500	29.0	17.0	11.9
R02a	2025	471500	173500	29.0	17.0	11.9
R03a	2025	471500	173500	29.0	17.0	11.9
R04a	2025	471500	173500	29.0	17.0	11.9
R05a	2025	471500	173500	29.0	17.0	11.9
R01b	2025	471500	173500	29.0	17.0	11.9
R02b	2025	471500	173500	29.0	17.0	11.9
R03b	2025	471500	173500	29.0	17.0	11.9
R04b	2025	471500	173500	29.0	17.0	11.9
R05b	2025	471500	173500	29.0	17.0	11.9

Appendix E Sensitivity Analysis

Modelled annual mean NO₂, PM₁₀ and PM_{2.5} concentrations at ground floor level (1.5m) locations of relevant exposure within the Site boundary are shown in Table 16. The modelling scenario utilised 2019 emission factors and background concentrations to represent the proposed opening year (2025).

Table 16: Model Predicted Annual Mean Concentrations – Sensitivity Analysis

Receptor	NO ₂ Concentration (µg/m ³)	% of AQAL	PM ₁₀ Concentration (µg/m ³)	% of AQAL	PM _{2.5} Concentration (µg/m ³)	% of AQAL
R01a	42.1	105	20.1	50	14.3	71
R02a	40.7	102	20.0	50	14.2	71
R03a	40.3	101	19.9	50	14.2	71
R04a	38.8	97	19.7	49	14.0	70
R05a	37.8	94	19.5	49	14.0	70
R01b	38.8	97	19.5	49	13.9	70
R02b	37.3	93	19.4	48	13.9	69
R03b	36.6	91	19.3	48	13.8	69
R04b	37.6	94	19.5	49	13.9	70
R05b	37.0	92	19.4	49	13.9	69

Notes:

Bold denotes an exceedance of the annual mean AQAL

It is worth noting that commercial use is proposed at ground floor level within Yield Hall Place 2 and therefore, only the short term NO₂ AQAL applies. As the predicted concentrations do not exceed 60µg/m³ the risk of exceeding the hourly NO₂ AQAL is low.

Appendix F Construction Dust Mitigation

In order to mitigate the worst-case dust impacts the following general mitigation measures are highly recommended by the IAQM for High Risk construction sites. Highly recommended mitigation measures applicable specifically to Demolition, Earthworks, Construction and Trackout are provided based on the respective risk of adverse impact.

Communications

- » Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- » Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- » Display the head or regional office contact information
- » Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London's guidance. The DMP may include monitoring of dust deposition, dust flux, real-time PM10 continuous monitoring and/or visual inspections.

Site Management

- » Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- » Make the complaints log available to the local authority when asked.
- » Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.
- » Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.

Monitoring

- » Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary
- » Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.
- » Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- » Agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

Preparing and Maintaining the Site

- » Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.

- » Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- » Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period
- » Avoid site runoff of water or mud.
- » Keep site fencing, barriers and scaffolding clean using wet methods.
- » Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- » Cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicle / Machinery and Sustainable Travel

- » Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NRMM standards, where applicable
- » Ensure all vehicles switch off engines when stationary - no idling vehicles.
- » Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- » Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- » Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

Operations

- » Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- » Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- » Use enclosed chutes and conveyors and covered skips.
- » Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- » Ensure equipment is readily available on site to clean any dry spillages, and clean up

Waste Management

- » No bonfires and burning of waste materials.

Measures Specific to Demolition

- » Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- » Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- » Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

- » Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- » Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
- » Only remove the cover in small areas during work and not all at once.

- » During dry or windy weather, material stockpiles and exposed surfaces should be dampened down using a water spray to minimise the potential for wind pick-up.
- » Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.

Measures Specific to Construction

- » Avoid scabbling (roughening of concrete surfaces) if possible
- » Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- » Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- » All construction plant and equipment should be maintained in good working order and not left running when not in use

Measures Specific to Trackout

- » Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- » Avoid dry sweeping of large areas.
- » Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- » Record all inspections of haul routes and any subsequent action in a site log book.
- » Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowzers and regularly cleaned.
- » Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- » Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- » Access gates to be located at least 10 m from receptors where possible.